# EFFECTS OF FIBER LENGTH UNIFORMITY ON PROCESSING PIMA COTTON



UNITED STATES
DEPARTMENT OF
AGRICULTURE

PRODUCTION
RESEARCH
REPORT
NUMBER 176

*PREPARED BY*
SCIENCE AND
EDUCATION
ADMINISTRATION

# ABSTRACT

Feaster, C. V., Ross, J. E., Turcotte, E. L., and Bragg, C. K., 1979. Effects of fiber length uniformity on processing Pima cotton. U.S. Department of Agriculture, Production Research Report No. 176, 11 pages.

Bales of commercial and experimental Pima cotton cultivars grown in Arizona were processed into combed 80s yarns to relate fiber properties to spinning performance and yarn quality. For these cottons, the amount of fiber in the 1- to 1-1/2-inch length group was a major contributor to spinning efficiency and yarn quality. P32, an experimental cultivar with an outstanding proportion of fibers in this group, gave few ends down, low waste, and strong yarn. Length distribution based on the usual groupings for Upland cotton of less than 1/2, 1/2 to 1, and longer than 1 inch did not relate to differences in spinning performance and yarn quality of these cottons. These results indicate a criterion for identifying Pima fiber types with improved spinning performance and yarn quality, namely, proportion of fiber in the 1- to 1-1/2-inch length group.



KEYWORDS: Comber noil, mill processing, spinning performance, fiber strength, yarn quality.



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Washington, D.C. 20402

Stock Number 001-000-03918-1

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Issued January 1979

# EFFECTS OF FIBER LENGTH UNIFORMITY ON PROCESSING PIMA COTTON

By Carl V. Feaster, John E. Ross, E. L. Turcotte, and C. K. Bragg[1]

## INTRODUCTION

Pima cotton has superior fiber characteristics for use in fine count yarns for manufacturing thread and high-quality textiles. Its fiber length is primarily 1-3/8 inches, strength about 30 g force per tex, and micronaire about 3.8.

In the Pima breeding program, fiber evaluations are initiated in the $F_2$ generation on individual plants. Yarn strength is obtained from microspinning tests of 50-g samples from progeny row through yield trials. Spinning tests consisting of 8-lb samples are initiated at the regional test stage to provide data on yarn strength and appearance, waste, and spinning potential of strains. These data are compared with fiber property measurements that are made on a continuing basis beginning in the $F_2$ generation.

These early stage evaluations permit the identification of strains with spinning characteristics that deviate from those indicated by their fiber properties. Large-scale spinning of the regional test entries serves to confirm or refute the early generation observations. Equally important is an evaluation of the strain for maintaining its level of fiber quality over a range of environments. When fiber property combinations differ from those in the trade, pilot plant studies provide an essential, indepth evaluation prior to mill evaluation.

This paper reports the fiber property combinations, processing efficiencies, and end-use suitabilities of five Pima cultivars.

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## MATERIALS AND METHODS

Fiber and spinning data were collected from Pima regional tests grown throughout the Pima belt. Fiber properties were determined at the SEA Fiber Laboratory, Phoenix, Ariz. Fiber length was measured on the Digital Fibrograph and expressed as 2.5-percent span length and 50-percent span length. The 2.5-percent span length is the length in inches on the test sample that is spanned by 2.5 percent of the fibers scanned at the initial starting point. The 50-percent span length is the length in inches on the test sample that is spanned by 50 percent of the fibers scanned at the initial starting point. Uniformity index is the ratio of 50-percent span length to 2.5-percent span length multiplied by 100. Fiber strength was measured in terms of grams force per tex on a stelometer with clamp jaws set one-eighth inch apart. Fiber fineness was measured on the micronaire and was reported in micronaire units. Higher readings indicate coarser fiber.

Spinning tests based on 8-lb samples were conducted by the Agricultural Marketing Service Laboratory, Clemson, S.C.

Two bales each of five Pima cultivars were obtained from Coolidge, Ariz. (low elevation), and four bales each from Safford, Ariz. (high elevation). A total of 30 bales, or 60 spinning lots, were assembled for pilot studies. In these tests, combers were set to remove 14-percent comber noils from all strains from both locations. This setting is done by trial and error on a small amount of stock. A small amount of sliver is produced, and the noils are collected and weighed. The percent noils is calculated, and the operator can adjust the comber to reach the desired level. The process is continued until the correct level is reached. With this method, the noil level remains relatively constant at the desired level. The comber setting is a function of fiber properties, particularly length distribution.

Cottons from Safford were also subjected to a constant setting for noil removal. This method involves setting the comber to produce typical noil levels for combed cotton and maintaining this setting throughout the study. Here, the comber settings are constant and the noil levels vary. A check cotton is used to assure a consistent comber operation. The check bale is selected as typical of the particular cottons to be studied. The comber is adjusted to produce a predetermined noil level (usually 14 percent) when combing the check cotton. Before each lot of test cotton is processed, a small amount of check cotton is processed through the comber. If the noil level is different from the original value, the comber is readjusted so that the combing action is the same for all test cottons processed in the study.

Preliminary plans for spinning specified two spindle speeds for all cottons so that a speed could be calculated that would yield a standard level of 40 ends down per thousand spindle hours for each cotton. Because of the range of fiber properties, a maximum speed of 13,000 revolutions per minute did not yield an ends down level of 40 for all test conditions. A spindle speed of 12,000 r/m was common for all cottons; therefore, an analysis of variance was possible for determining the significance of any differences among the various cottons.

Each lot was processed into 80s combed yarn using the following manufacturing organization:

| | |
|---|---|
| Picking: | 14-oz lap |
| Carding: | 55 grain sliver, 20 lb/hr |
| Breaker drawing: | 8 ends up, 42 grain sliver, 265 ft/min |
| Lap winding: | 20 ends up, 806 grains/lap |
| Combing: | 53 grain sliver |
| Finisher drawing: | 8 ends up, 55 grain sliver, 265 ft/min |
| Roving: | 1.75 hank, 1.10 twist multiplier, 900 spindle speed |
| Spinning: | 80s yarn, 3.04 twist multiplier, 11,000 r/m, 12,000 r/m, and 13,000 r/m spindle speed |

Due to mechanical malfunctions in spinning, the data generated for three strains (Pima S-4, Pima S-5, and P32) from Coolidge were not acceptable for analysis. No statistical comparisons could be made between locations for any of the strains. Some general comparisons were made based on the fiber properties.

## RESULTS AND DISCUSSION

### Regional Tests

Average fiber properties for two commercial cultivars (Pima S-4 and Pima S-5) and three experimental cultivars (P28, P30, and P32) for 1974 and 1975 are included in table 1. The P30 cultivar had the longest 2.5-percent span length, followed by the recently released Pima S-5, Pima S-4, P28, and P32. The difference among cultivars for 50-percent span length was less pronounced, resulting in major differences in fiber length uniformity. Fiber strength differences were minimal except for P32.

TABLE 1.--*Average fiber properties from 8 tests in 1974 and 6 tests in 1975*[1]

| Cultivar | Fiber span length | | Length uniformity index | T[1] strength | Micronaire |
|---|---|---|---|---|---|
| | 2.5 percent | 50 percent | | | |
| | *Inches* | *Inches* | | *Gf/tex* | |
| Pima S-4 | 1.37 | 0.71 | 52 | 30.1 | 3.9 |
| Pima S-5 | 1.38 | .72 | 52 | 30.7 | 3.9 |
| P28 | 1.34 | .72 | 54 | 30.5 | 3.8 |
| P30 | 1.45 | .73 | 50 | 30.6 | 3.9 |
| P32 | 1.30 | .70 | 54 | 32.2 | 3.9 |

[1]Determination made at the SEA Fiber Laboratory, Phoenix, Ariz.

Small-scale spinning tests were conducted in 1974 and 1975 (table 2). The strongest and highest quality yarns were obtained from P32, which had the strongest fiber and most uniform fiber length, but the shortest 2.5-percent span length. P32 also gave less total waste in processing.

TABLE 2.--*Yarn quality and waste from 4 tests in 1974 and 4 tests in 1975*

| Cultivar | Yarn skein strength | | | Yarn appearance index | Yarn imperfections | | Waste | | |
|---|---|---|---|---|---|---|---|---|---|
| | 50s | 80s | Average break factor | | 50s | 80s | Picker and card[1] | Comber | Total |
| | *Pounds* | | | | *No.* | | *Percent* | | |
| Pima S-4 | 67 | 35 | 3,078 | 114 | 2 | 1 | 11.6 | 17.0 | 26.6 |
| Pima S-5 | 67 | 36 | 3,064 | 113 | 1 | 2 | 11.7 | 16.5 | 26.3 |
| P28 | 71 | 38 | 3,301 | 109 | 3 | 2 | 13.9 | 16.9 | 28.4 |
| P30 | 68 | 36 | 3,152 | 104 | 3 | 3 | 13.8 | 19.3 | 30.4 |
| P32 | 72 | 19 | 3,356 | 120 | 2 | 1 | 10.6 | 15.9 | 24.8 |

[1] 4.5 lb/hr.

The superior yarn quality and unusual combination of fiber properties of P32, and the length uniformity index differences among certain other experimental cultivars, stimulated the following indepth study of the effect of length uniformity and other fiber properties on the manufacture of fine count combed yarns from extra-long staple cottons.

## Pilot Spinning Tests

### Fiber Quality

The properties of the fiber involved in the pilot spinning tests were determined on ginned lint and drawing sliver. For ginned lint, there were no significant differences in classers' grade among the Pima cultivars at Coolidge, but significant differences were noted at Safford (table 3), where colorimeter measurements were confounded by fiber color and trash content differences among cultivars. At Safford, the trash content of P28, as indicated by the Shirley Analyzer waste, may account for its somewhat higher colorimeter reading on ginned lint. P28 strings out of the boll shortly after opening, and the seed cotton tends to encompass more trash during machine picking.

Classers' staple lengths were not significantly different among cultivars at either location. The 2.5-percent span fiber lengths showed that P32 was shorter than the other cultivars. This was substantiated by the upper quartile length as measured by the array method. The P30 strain was longer than the other cultivars by either measurement. Uniformity index as measured by the fibrograph was higher for P32 than for the other cultivars. The 2.5-percent span length, upper quartile, and uniformity index for P32 were significantly different from the other cultivars at Safford but not all cultivars at Coolidge.

Fiber strength levels for the zero gage and 1/8-inch gage tests indicated

TABLE 3.--*Fiber quality of ginned lint for Pima cultivars by location, 1974*

| Quality item | Safford | | | | | Coolidge | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S-4 | S-5 | P28 | P30 | P32 | S-4 | S-5 | P28 | P30 | P32 |
| Grade (Classer)[1] | [2]3.75 c | 4.50 b | 6.00 a | 4.75 b | 3.75 c | 3.50 a | 4.00 a | 4.00 a | 3.50 a | 3.00 a |
| Colorimeter:[1] | | | | | | | | | | |
| Ginned lint | 3.00 b | 3.50 b | 5.00 a | 3.75 ab | 2.50 b | 2.00 a | 2.50 a | 2.00 a | 2.50 a | 1.50 a |
| Clean lint | 1.25 b | 1.50 ab | 2.25 a | 2.25 a | 1.25 b | 1.50 a | 1.50 a | 1.50 a | 1.00 a | 1.00 a |
| Staple length, 32d inch | 44.0 a | 44.0 a | 44.0 a | 44.0 a | 44.0 a | 44.0 a | 45.0 a | 44.0 a | 45.0 a | 44.0 a |
| 2.5-percent span length, inches | 1.36 c | 1.40 b | 1.35 c | 1.44 a | 1.28 d | 1.41 b | 1.42 b | 1.36 c | 1.48 a | 1.34 c |
| 50-percent span length, inches | .58 d | .60 bc | .61 ab | .62 a | .60 bc | .62 a | .64 a | .62 a | .66 a | .63 a |
| Uniformity index, percent | 43.0 c | 43.0 c | 45.5 b | 43.0 c | 46.8 a | 44.0 b | 44.5 b | 46.0 ab | 44.0 b | 47.0 a |
| Strength: | | | | | | | | | | |
| "0" gage, mpsi | 96.2 c | 95.8 c | 98.8 b | 100.05 a | 101.8 a | 103.0 bc | 100.5 c | 103.5 ab | 105.0 ab | 106.5 a |
| "1/8" gage, gf/tex | 32.5 ab | 30.9 c | 31.7 bc | 32.8 ab | 33.4 a | 34.7 b | 34.6 b | 34.3 b | 35.4 ab | 35.9 a |
| Micronaire | 3.9 a | 3.9 a | 3.9 a | 4.0 a | 4.0 a | 3.6 a | 3.6 a | 3.6 a | 3.6 a | 3.5 b |
| Shirley Analyzer waste, percent | 3.02 ab | 2.85 ab | 3.84 ab | 3.51 ab | 2.61 b | 3.44 a | 3.79 a | 3.57 a | 3.49 a | 3.30 a |
| Array: | | | | | | | | | | |
| Upper quartile length[3] | 1.46 c | 1.50 b | 1.44 c | 1.55 a | 1.38 d | 1.52 b | 1.56 ab | 1.47 c | 1.58 a | 1.45 c |
| Mean length[3] | 1.18 b | 1.20 b | 1.20 b | 1.26 a | 1.16 b | 1.26 a | 1.31 a | 1.22 a | 1.30 a | 1.22 a |
| C.V. percent | 31.2 a | 32.8 a | 29.8 ab | 31.0 a | 27.0 b | 28.5 a | 27.5 a | 29.0 a | 31.0 a | 26.0 a |

[1]Pima grades are numerical; grade 1 is highest, 10 is lowest.

[2]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test. Each location analyzed separately.

[3]Inches.

that the P32 cultivar was the strongest of the five cottons at both locations. The level of fiber strength for the P30 strain was slightly higher than the others. Fiber strength was consistently higher for each of the five strains from Coolidge than from safford.

There were minor differences in micronaire among cultivars at Safford and Coolidge and only slightly greater differences between locations. The finer fiber from Coolidge may account for the higher strength from Coolidge, since strength is measured as bundle strength, and finer fiber results in more fibers per cross sectional area.

Fiber property measurements from drawing sliver (table 4) differed somewhat from the measurements made on ginned lint. Combing long staple cotton is a normal process prior to manufacturing fine yarns. Basically, combing cotton removes a large proportion of short fibes on comber noils and parallels the fibers. Fibers generally are lengthened as some of the crimp is removed.

The relative fiber length differences among cultivars were similar when based on either drawing sliver or ginned lint, but lengths were considerably greater when measured on drawing sliver. Fiber strength as measured on drawing sliver. Fiber strength as measured by the zero gage was about equal for all strains at both locations. The strength from drawing sliver was decreased considerably from that of the ginned lint. When strength was measured on the 1/8-inch gage only a small decrease, if any, occurred from drawing sliver.

## Processing

Spinning performance, as measured by ends down per thousand spindle hours (EDMSH), was similar for the three experimental cultivars (P28, P30, and P32). Their level of about 18 EDMSH compares with 35 for the recently released Pima S-5 and 47 for Pima S-4 (table 5).

Yarn break factors for the three experimental cultivars were higher than for the commercial cultivars. At Coolidge, P32 yarn was significantly stronger than that of P28 and P30. Yarn appearance was equal for all cultivars.

Single strand data for strength, elongation, strength variations, and thick and low places per thousand yards of yarn indicated that the three experimental cultivars have higher quality than does Pima S-4 or Pima S-5. P32 had fewer neps at both locations, although not statistically significant at the 95-percent confidence level.

Opening, picking, and card waste from P28 was highest, which reflects its slightly lower grade (table 6). Generally, P32 produced less waste than did the other cultivars.

The spinning performance and yarn quality of yarns manufactured from sliver combed by the two methods were similar (table 7). The advantage to be gained from using a constant comber setting would be the lower noil level for P32 (table 6).

TABLE 4.--*Fiber quality of drawing sliver for Pima cultivars by location, 1974*

| Quality item | Safford | | | | | Coolidge | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S-4 | S-5 | P28 | P30 | P32 | S-4 | S-5 | P28 | 30 | P32 |
| Fibrograph: | | | | | | | | | | |
| 2.5-percent length, inches | [1]1.44 c | 1.49 b | 1.42 d | 1.53 a | 1.35 e | 1.44 b | 1.46 b | 1.42 c | 1.53 a | 1.38 a |
| 50-percent length, inches | .76 ab | .75 b | .75 b | .78 a | .74 b | .74 a | .74 a | .74 a | .75 a | .73 a |
| Uniformity index, percent | 52.5 b | 50.5 c | 52.8 b | 51.0 b | 54.8 a | 51.0 a | 51.0 a | 52.5 a | 49.0 b | 52.5 a |
| Strength: | | | | | | | | | | |
| "0" gage, mpsi | 91.8 a | 91.8 a | 94.2 a | 93.8 a | 94.8 a | 98.5 a | 98.5 a | 95.5 a | 97.5 a | 98.0 a |
| "1/8" gage, gf/tex | 30.7 b | 31.7 ab | 31.4 ab | 31.9 ab | 32.3 a | 33.8 ab | 34.6 ab | 33.2 b | 34.6 ab | 36.0 a |
| Micronaire | 4.1 a | 4.0 a | 4.0 a | 4.1 a | 4.0 a | 3.6 a | 3.6 a | 3.5 a | 3.6 a | 3.4 a |
| Array: | | | | | | | | | | |
| Upper quartile length[2] | 1.49 c | 1.54 b | 1.48 c | 1.57 a | 1.42 d | 1.55 bc | 1.56 a | 1.52 cd | 1.62 a | 1.49 d |
| Mean length[2] | 1.25 bc | 1.30 a | 1.26 b | 1.31 a | 1.22 c | 1.31 bc | 1.32 a | 1.28 d | 1.36 a | 1.29 cd |
| C.V., percent | 25.8 a | 25.0 ab | 23.8 bc | 26.2 a | 22.5 c | 25.0 a | 25.0 a | 24.0 a | 25.5 a | 21.5 b |

[1]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test. Each location analyzed separately.
[2]Inches.



TABLE 5.--*Processing performance and yarn quality for pima cultivars by location, 1974*

| Quality item | Safford | | | | | Coolidge | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | S-4 | S-5 | P28 | P30 | P32 | S-4 | S-5 | P28 | P30 | P32 |
| EDMSH[1] | [2]47 a | 35 b | 18 c | 17 c | 18 c | ([3]) | ([3]) | ([3]) | ([3]) | ([3]) |
| Break factor | 2,176 b | 2,209 b | 2,446 a | 2,478 a | 2,518 a | 2,753 d | 2,762 d | 2,876 c | 2,984 b | 3,116 a |
| Yarn appearance index | 119 a | 118 a | 118 a | 120 a | 119 a | 115 a | 116 a | 117 a | 120 a | 118 a |
| Single strand data: | | | | | | | | | | |
| Strength, grams | 106.8 b | 111.8 b | 119.2 a | 123.2 a | 121.5 a | 132.0 c | 133.5 c | 141.0 b | 141.0 b | 155.0 a |
| Elongation, percent | 5.28 c | 5.48 b | 5.42 bc | 5.25 c | 5.80 a | 5.40 bc | 5.40 bc | 5.60 ab | 5.00 c | 5.90 a |
| Strength C.V., percent | 11.42 ab | 12.25 a | 11.08 ab | 11.08 ab | 10.58 b | 11.30 a | 10.65 a | 11.00 a | 10.30 a | 10.35 a |
| Neps/1,000 yd | 271.8 ab | 261.2 ab | 299.5 a | 268.5 ab | 225.2 b | 268.5 a | 300.5 a | 291.0 a | 303.0 a | 211.0 a |
| Thick places/1,000 yd | 1,116 a | 1,142 a | 1,004 b | 977 b | 961 b | 1,019 a | 862 abc | 970 ab | 806 bc | 719 c |
| Low places/1,000 yd | 2,999 a | 3,031 a | 2,608 b | 2,541 b | 2,717 b | 2,790 a | 2,548 ab | 2,442 bc | 2,202 c | 2,140 c |
| Irregularity C.V., percent | 18.40 a | 18.50 a | 17.88 b | 17.65 b | 17.82 b | 18.10 a | 17.75 bc | 17.55 abc | 17.20 bc | 16.80 c |

[1]Ends down per 1,000 spindle hours.
[2]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test. Each location analyzed separately.
[3]Not available.
[4]B = 110; B+ = 120.

TABLE 6.--*Waste and comber noils data for Pima cultivars, 1974*[1]

| Type waste | S-4 | S-5 | P28 | P30 | P32 |
|---|---|---|---|---|---|
| Opening and picking | [2]0.535 c | 0.700 b | 0.875 a | 0.688 c | 0.490 c |
| Card waste | 1.990 c | 2.058 bc | 2.445 a | 2.105 b | 1.708 d |
| Comber noils: | | | | | |
| 14-percent set | 14.95 a | 14.40 a | 14.35 a | 14.45 a | 14.90 a |
| Constant set | 14.40 a | 15.15 a | 14.10 a | 14.15 a | 11.95 b |

[1]Safford location.
[2]Means followed by the same letter or group of letters are not different based on the 0.05 level of Duncan's multiple range test.

## Length-distribution Characteristics

A general axiom has existed almost since the advent of ring spinning that long fiber is required for manufacturing finer yarns. Also, for combed yarns, low short fiber content is essential for low waste in processing.

The relation among short fibers, medium length fibers, and long fibers in any cotton is generally characterized by measures of its length distribution. Lenght distribution may be indicated by uniformity indexes, variability coefficients, or short fiber content.

In this test, the central issue was whether a stronger and shorter, but much more uniform in length, Pima cotton could perform as well as conventional longer cottons in the manufacture of 80s yarn. Most Pima cotton is used in the manufacture of thread or sales yarn in yarn counts up to 80s. Small amounts are used, either wholly or in combination with imported extra long staple cottons, in counts ranging up to 120s for manufacturing typewriter ribbons.

As shown above, the fiber from P32 is significantly shorter with a much higher length uniformity than is the fiber from its commercial counterparts or two experimental strains. Its yarn qualities are equal to that of the longer experimental cottons and much greater than that of commercial cultivars. An examination of popular measurements of length and length distribution on ginned lint showed that P32 had significantly less shorter fibers than the commercial cultivars, but did not differ significantly for percentage of fibers from 1/2 to 1 inch or longer than 1 inch (table 8). These length classes are commonly used for determining Upland length distributions, and may be too short for properly distinguishing length distributions among Pima cultivars.

A shift upwards of one-half inch of each class provides a clue to the outstanding performance of P32. The amount of fibers, by weight, in the 1- to 1-1/2-inch group was significantly higher for P32. There were no significant differences among cultivars for amount of fibers less than 1 inch, but P32 had significantly less fibers in the group with fibers longer than 1-1/2 inches.

A similar analysis of finisher drawing sliver shows all cultivars had approximately 2 percent of fibers less than 1/2 inch, 15 percent from 1/2 to 1

TABLE 7.--*Processing performance and yarn quality data for Pima cultivars and by type of comber setting, 1974*

| | S-4 | | S-5 | | P28 | | P30 | | P32 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 14 percent | Constant | 14 percent | Constant | 14 percent | Constant | 14 percent | Constant | 14 percent | Constant |
| EDMSH[1] | 40.00 | 45.5 | 34.0 | 35.5 | 19.5 | 15.5 | 18.0 | 15.5 | 20.5 | 15.5 |
| Break factor | 2,163 | 2190 | 2,257 | 2,161 | 2,517 | 2,374 | 2,526 | 2,431 | 2,527 | 2,509 |
| Yarn appearance index[2] | 120 | 118 | 118 | 118 | 120 | 116 | 118 | 120 | 118 | 120 |
| Single strand data: | | | | | | | | | | |
| Strength, grams | 106 | 107 | 112 | 112 | 120 | 119 | 125 | 122 | 123 | 120 |
| Elongation, percent | 5.30 | 5.25 | 5.45 | 5.50 | 5.40 | 5.45 | 5.25 | 5.25 | 5.75 | 5.85 |
| Strength C.V., percent | 11.45 | 11.46 | 12.80 | 11.70 | 11.05 | 11.10 | 10.85 | 11.30 | 10.40 | 10.75 |
| Neps/1,000 yd | 320 | 223 | 301 | 222 | 350 | 249 | 320 | 217 | 255 | 195 |
| Thick places/1,000 yd | 1.115 | 1,116 | 1,204 | 1,080 | 1,036 | 973 | 982 | 972 | 969 | 952 |
| Low places/1,000 yd | 2,994 | 3,004 | 3,132 | 2,930 | 2,674 | 2,542 | 2,580 | 2,502 | 2,646 | 2,788 |

[1]Ends down per 1,000 spindle hours.
[2]B = 110; B+ = 120.

TABLE 8.--*Proportion of fibers by specified length groups (array) and performance data for Pima cultivars, 1974*

| Quality item | S-4 | S-5 | P28 | P30 | P32 |
|---|---|---|---|---|---|
| Ginned lint, percent fibers by weight:[1] | | | | | |
| Less than 1/2 inch | 8.0 b | 8.0 b | 6.8 ab | 7.0 ab | 5.2 a |
| 1/2 to 1 inch | 17.0 ab | 17.5 a | 15.8 ab | 13.8 b | 18.6 a |
| Longer than 1 inch | 74.6 a | 73.8 a | 77.1 a | 78.5 a | 75.8 a |
| Less than 1 inch | 25.0 a | 25.5 a | 22.6 a | 20.8 a | 23.8 a |
| 1 to 1-1/2 inches | 55.0 c | 49.4 d | 59.2 b | 47.2 d | 65.9 a |
| Longer than 1-1/2 inches | 19.6 c | 24.4 b | 17.9 c | 31.3 a | 9.9 c |
| Drawing sliver, percent fibers by weight:[2] | | | | | |
| Less than 1/2 inch | | | | | |
| 1/2 to 1 inch | 17.6 a | 14.6 b | 14.6 b | 15.0 b | 15.8 ab |
| Longer than 1 inch | 79.2 b | 82.4 a | 82.4 a | 81.7 ab | 81.5 ab |
| Less than 1 inch | 20.4 a | 17.1 b | 16.8 b | 17.8 ab | 17.8 ab |
| 1 to 1-1/2 inches | 56.2 c | 51.9 d | 61.7 b | 48.6 e | 68.3 a |
| Longer than 1-1/2 inches | 23.2 a | 30.4 a | 20.8 b | 33.1 a | 13.2 c |
| EDMSH[3] | 47 a | 35 b | 18 c | | |
| Break factor | 2,176 b | 2,209 b | 2,446 a | 2,478 a | 2,518 a |

[1]Ginned lint for Safford.
[2]Drawing sliver for Safford, 14 percent and constant combing, combined.
[3]Ends down per 1,000 spindle hours.

inch, and 80 percent longer than 1 inch. When each class was shifted upwards one-half inch, the amount of fibers, by weight, in the group with fibers longer than 1-1/2 inches was considerably less for P32, and there were only minor differences among cultivars in the amount of fibers less than 1 inch. Sixty-eight percent of the fibers of P32 were in the 1- to 1-1/2-inch group, an amount considerably greater than for the other cultivars. The amount of fibers in the 1- to 1-1/2-inch length group appears to contribute much to spinning efficiency and yarn quality of P32 in manufacturing fine combed yarn strength, but in comparison of P28 and P30 eliminates fiber strength differences (table 1). The significantly higher proportion of fibers longer than 1-1/2 inches for P30 over P28 did not give a significantly higher yarn strength for P30 over P28 (table 8). This further supports the concept that the 1- to 1-1/2-inch length group is a major contributor to high spinning performance.

## SUMMARY

In the Pima breeding program, fiber evaluations are initiated on individual plants in the $F_2$ generation. Yarn strength is obtained from microspinning tests on 50-gram samples from progeny row through yield trials. Spinning tests con-

sisting of 8-pound samples are initiated at the regional test stage to provide data on yarn strength and appearance, waste, and spinning potentials of strains. This procedure is necessary for developing Pima cotton cultivars with superior fiber characteristics for use in fine count yarns for manufacturing thread and high-quality textiles.

It was noted in the breeding program that a high-quality yarn could be obtained from a varied combination of fiber properties. To better evaluate these fiber property combinations, a pilot study was undertaken. Two bales each of five Pima cultivars were obtained from Coolidge, Ariz. (low elevation), and four bales each from Safford, Ariz. (higher elevation). In these tests, combers were set to remove 14-percent comber noils from all strains at both locations. Cottons from Safford also were subjected to a constant setting for noil removal. Spindle speeds varied from 11,000 to 13,000 r/m with a spindle speed of 12,000 r/m, for all cottons.

The properties of the fibers involved in the pilot spinning tests were determined on ginned lint and drawing sliver. Classers' staple lengths were not significantly different among cultivars at either location, but 2.5-percent span fiber lengths and upper quartile lengths showed that P32 was shorter but more uniform in length than the other cultivars. P32 was the strongest of the five cottons at both locations. There were only minor differences in micronaire among cultivars at both locations.

Spinning performance for the three experimental cultivars, as measured by ends down per thousand spindle hours and yarn break factor, was better than for the two commercial cultivars. Essentially, there was no difference in the amount of comber noils produced by the two methods of removing noils, except for P32. The amount of comber noils removed from P32 by constant setting was about 3 percentage points less than for the other cultivars.

Fiber length distribution is generally characterized by the relation among short fibers, medium length fibers, and long fibers. For these cottons, the amount of fiber in the 1- to 1-1/2-inch length group was a major contributor to spinning efficiency and yarn quality. Length distribution based on the usual grouping for Upland cotton of less than 1/2 inch, 1/2 to 1 inch, and longer than 1 inch did not relate to differences in spinning performance and yarn quality of these cottons. A shift upwards of one-half inch in each length class from that for Upland cotton provided a clue to the outstanding performance of a relatively short but uniform length Pima cotton.



U.S. GOVERNMENT PRINTING OFFICE : 1979 O—285-095

U.S. DEPARTMENT OF AGRICULTURE
SCIENCE AND EDUCATION ADMINISTRATION
HYATTSVILLE, MARYLAND 20782

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